

ECE 480 – Team 5

Introduction to MAVRK module

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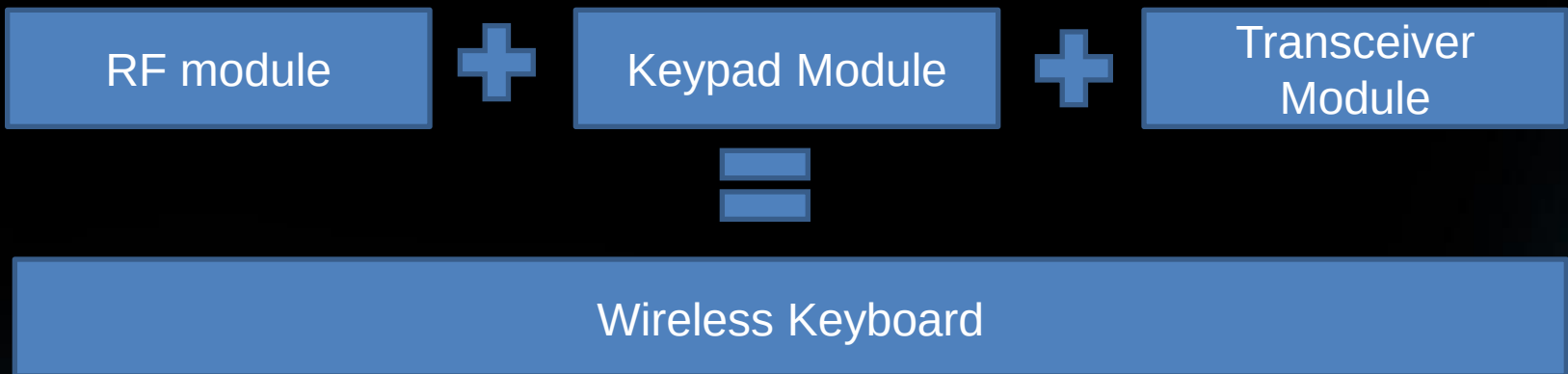


Introduction

- Definition of MAVRK
- Component of MAVRK starter Kit
- Component of uMAVRK
- Module design procedure
- Programming procedure
- Question

What is MAVRK

- Modular and Versatile Reference Kit
- Hardware prototyping platform from TI
- Purpose
 - Help developer focus on system-level design
- Modules = functions on programming



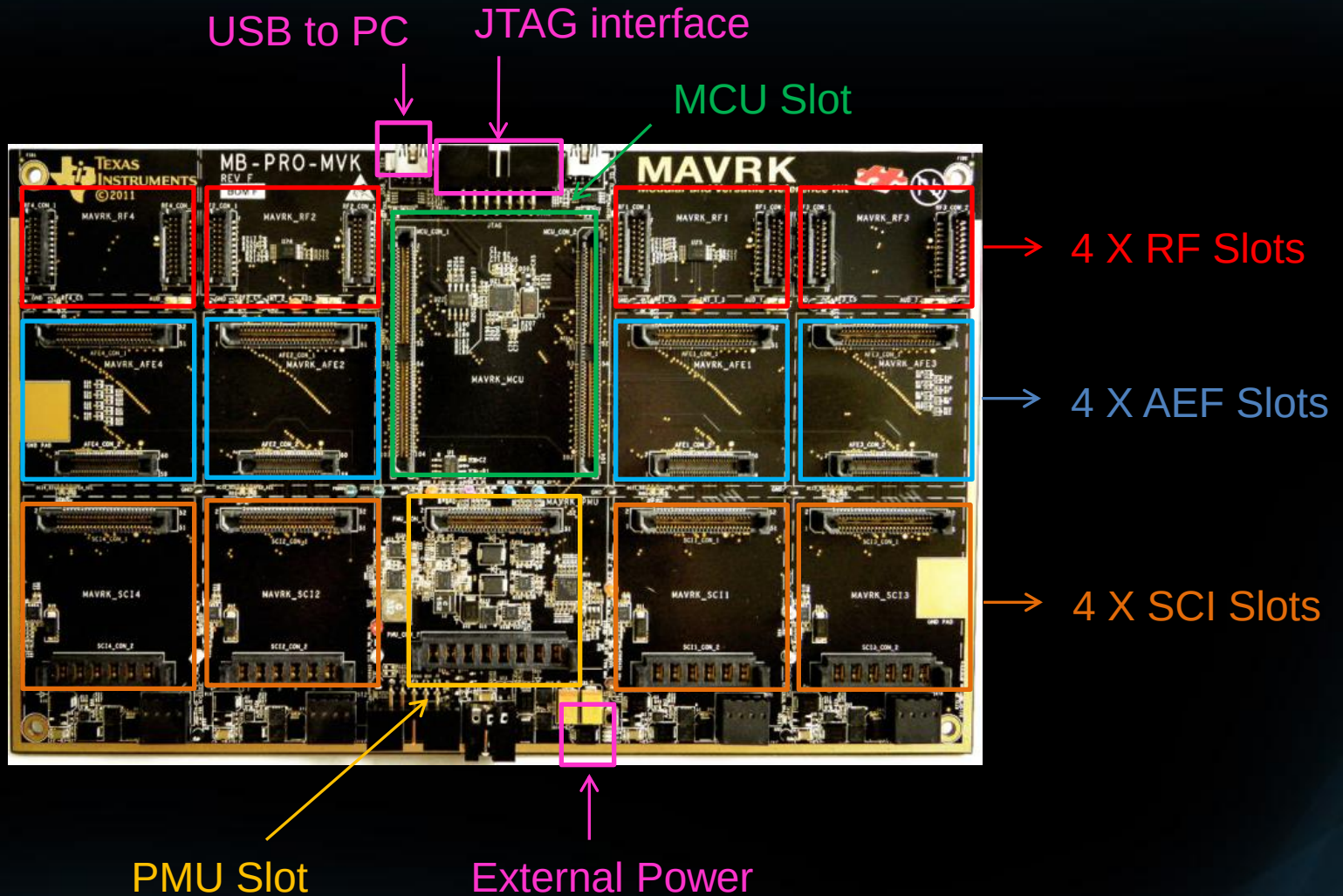
Contents of MAVRK starter kit

- **DSP unit - MCU-430F5438A-MKV**
- **Mother Board - MB-PRO-MKV**
- **Test Unit – AFE-BREAKOUT-MKV**
- **Emulation tool - MSP-FET430UIF**

Mother Board

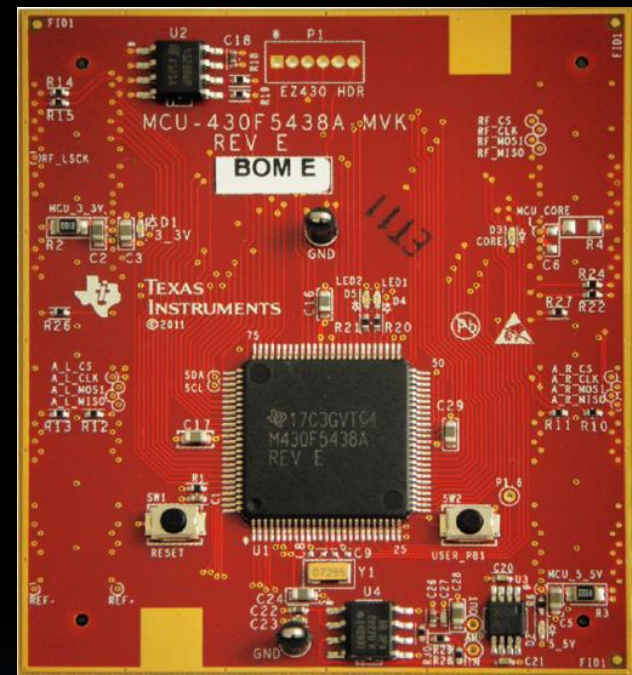
- Main Platform to connect all the MAVRK module
- Slot distribution
 - 4 x Signal Processing Interface (ie. Filters)
 - 4 x Analog End Front (ie. Amplifier)
 - 4 x RF
 - 1 x Micro Control Unit
 - 1 x Power Management Unit
- Interface
 - JTAG : Programing MCU unit
 - USB to PC : powering up MAVRK Motherboard and module
/ communication with GUI

MAVRK Mother Board



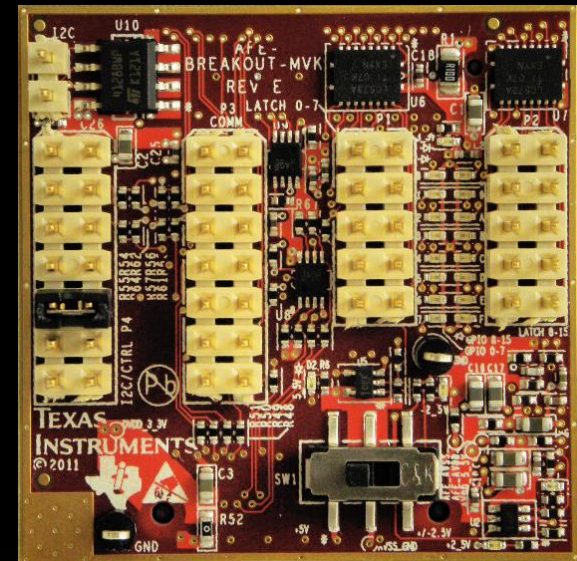
DSP unit - MCU-430F5438A-MKV

- Ultra low power mixed signal microcontroller
- Provides connectivity to a PC-based GUI application
- Spec
 - 25MHz CPU speed, 256k Flash Memory, 16k RAM
- Features
 - 3 x 16-bit timer
 - 1 x 12-bit ADC
 - 4 x USCI
 - 1 x 32-Bit Hardware Multiplier
 - Precision Voltage Reference
 - Real-time clock with alarm
 - Up to 87 I/O pins
 - On-Board error check LED



AFE breakout board

- Enables Easy Debug of AFE bus
- LED indicators to observe pin activity
- Enables probing/connecting to external circuitry

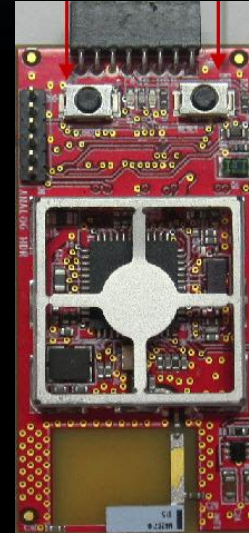


Contents of uMAVRK starter kit

- **Test Unit – RF-UDEBUG-MKV**
- **uMAVRK unit**
- **Sensor Module**
- **Power Module**

uMAVRK

- Remote Version of MAVRK
- CC430F5317 used as MCU
- Antenna used as RF module
- PMU from 8 – pin connector
- 6-pin Analog heading
 - external inputs for ADC conversion



uMAVRK

PMU



User



Reset



Analog Heading →



40-pin analog connector
(back panel)



Analog Light Sensor



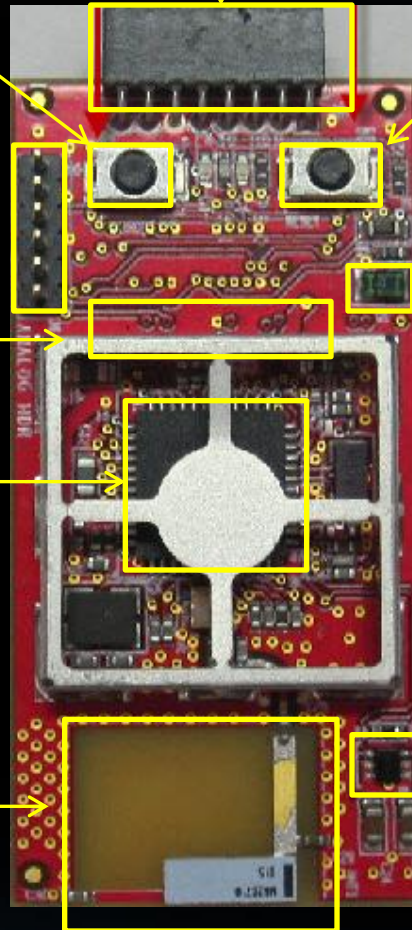
CC430 DSP unit



902-928Mhz
Antenna



Analog temp Sensor



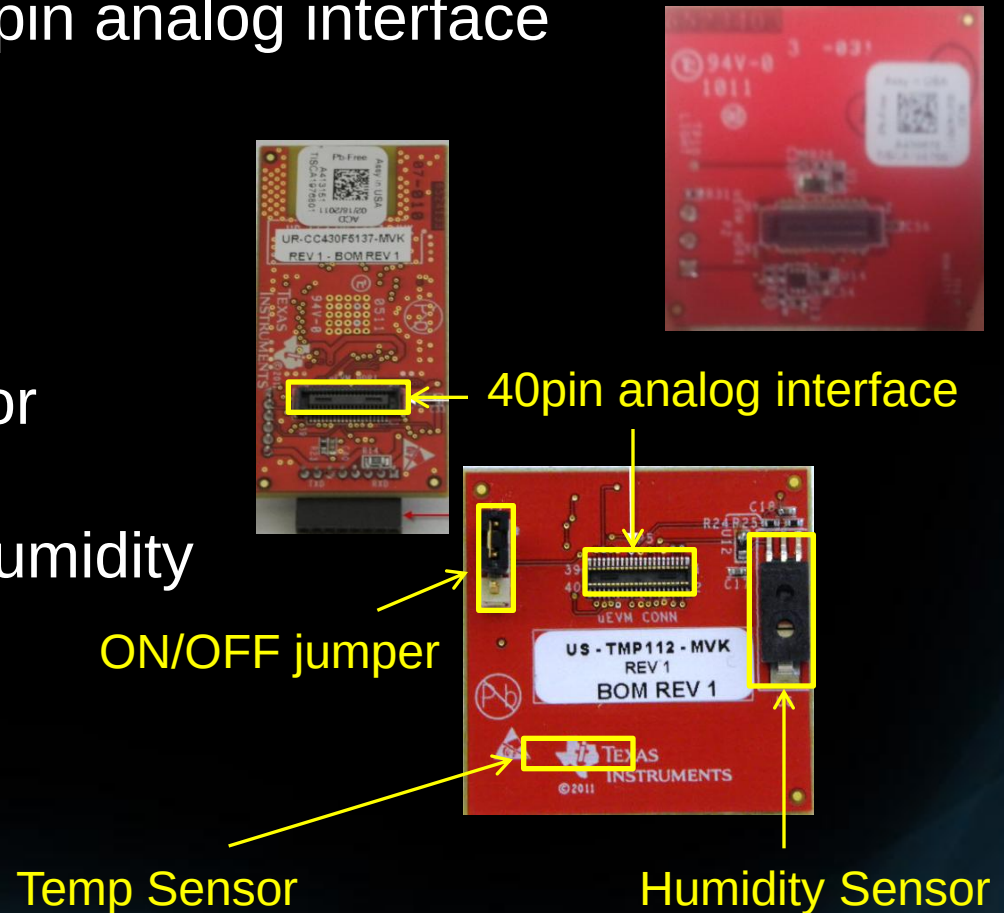
CC430F5137

- Spec
 - 32kB flash, 4kB Ram,
- Features
 - 12-bit ADC with 6 external input
 - 2 x 16-bit timer
 - Comparator
 - Internal Temp / Battery sensor
 - USCI_A (UART, IrDA, SPI)
 - USCI_B (I^2C , SPI)
 - 32-Bit Hardware Multiplier
 - Real-time clock
 - Up to 30 I/O pins
 - DMA



uMAVRK Sensor Module

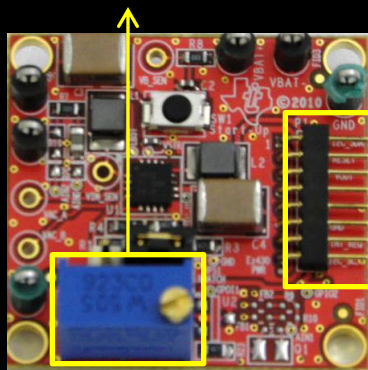
- Sensor Module
 - Connection Via 40pin analog interface
 - 3 type of sensors
 - Temperature
 - Humidity
 - Light
- Data transfer by I2C for temp / light
- ADC conversion for Humidity



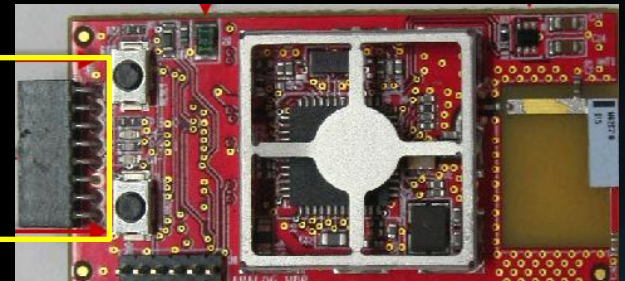
Modules of uMAVRK

- Power Module
 - Supplies 3 to 3.3Vdc
 - Power Harvest Feature
 - Li-ion Battery
 - Can be replaced by 2 1.5V AAA Battery

Power Harvest Feature



uMAVRK connection



Sensor Module Design Procedure Issues

- Component Selection
- Design
- Testing & Probing

Component Selection

- Supply voltage within 2.7V ~ 3.3V
- Current draw no more than 3mA
- Avoid large sized packaging
 - nullify mobility of uMAVRK
 - height of components

Design

- Design Varies by application
- Sensor module with Resistive Component
 - Issue : low voltage/current supply
 - Noise cancelation
 - Wheatstone Bridge
 - Differential OP AMP
 - Non inverting OP AMP

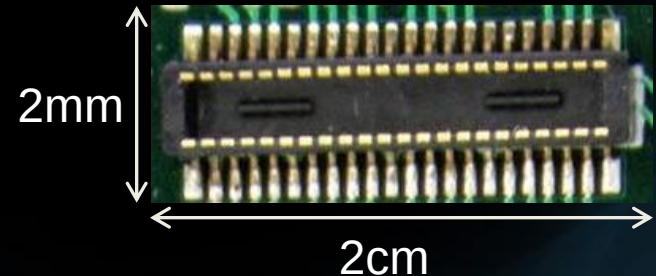
design

OP AMP selection

- Single Voltage Supply
 - OP AMP with dual supply has to be powered by extra inverting amplifier
 - With voltage divider, $\pm 1.5\text{V}$ range
- Low offset voltage
 - Voltage output in steps of 10~50mV range
 - Low voltage offset reduces error in ADC conversion
- Low quiescent current
 - GPIO is setup to supply only 3mA Current
- Vout to be in range of 0 ~ 3V
 - Vref set to 3V max

RF-UDEBUG module

- Breakout board for uMARVK
 - enables easy pin access
 - Powered Via MAVRK motherboard or battery source
- Can be programmed to access all 40 pins on CC430
- Component
 - 40 pin female analog interface
 - Power Source Selector
 - JTAG connector
 - SPI/I2C Interface
 - Analog interface



Testing

RF-UDEBUG MODULE

Battery Connector

Analog Interface (AFE)

On/OFF Switch

JTAG Connector

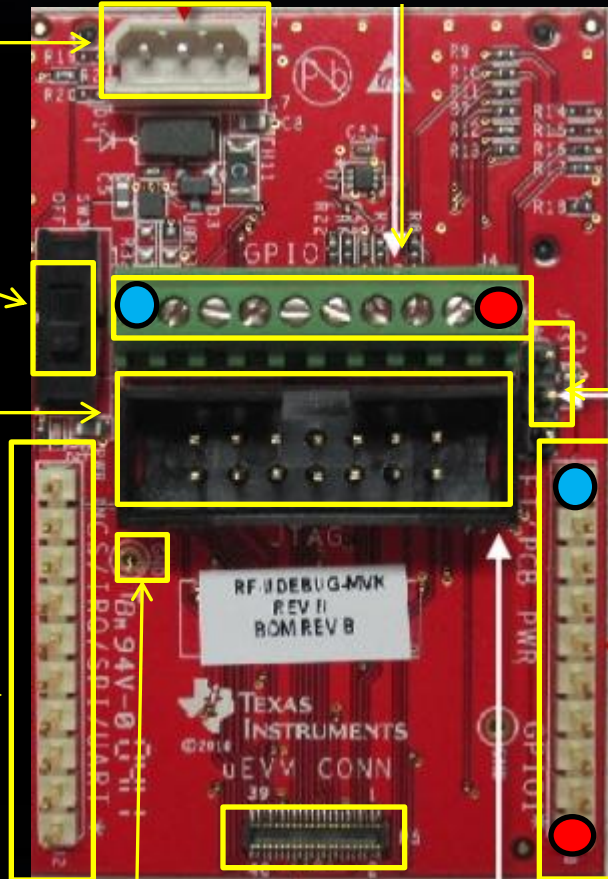
Power Source Selector

SPI/I2C interface

PMU interface

GND

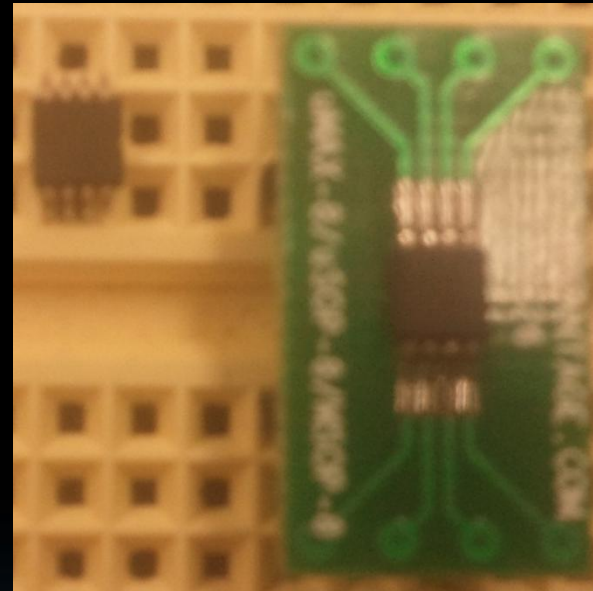
40-Pin Connector



Testing

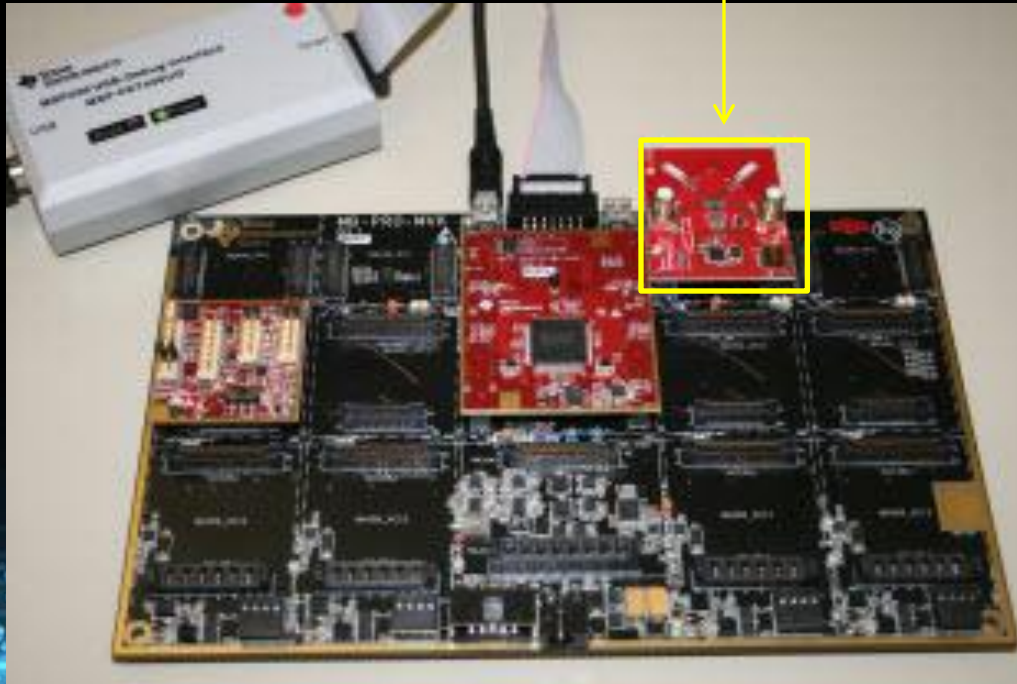
DIP Adapter

- Small sized packaging – impossible to make connection.
- Implement DIP adapter
- Commercial site available for IC adapter implementation



Setup-programming the Mavrk

RF-Tranceiver



Jtag debug interface attached to the MSP and connected to usb

Power cord attached to motherboard and connected to sub

RF-CC1101 – attached in rf slot.

Build code and load!

RF Transceiver – CC1101

- CC1101 is a low-power RF transceiver
- Receive information sent from the transmitter on the uMavrk.
Attached on the RF slot.

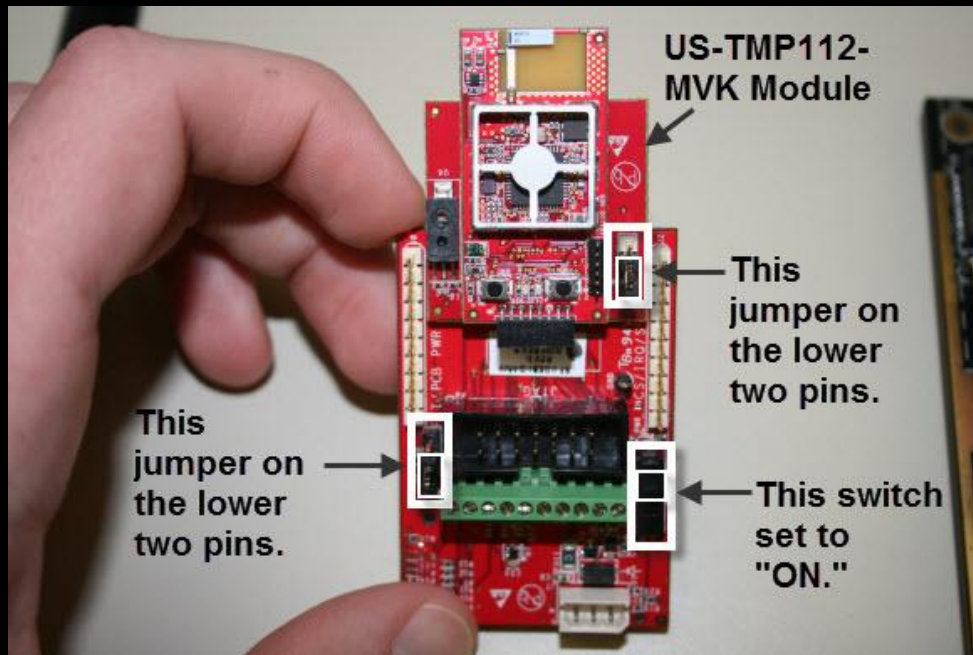
```
/* **** Initialize the Radios **** */
/* **** */
#define TRANSMITTER_SLOT MAVRK_RF2
mvrk_initialize_transmit_radio (TRANSMITTER_SLOT);
#define RECEIVER_SLOT MAVRK_RF1
mvrk_initialize_receive_radio (RECEIVER_SLOT);
// #define TRANSCEIVER_SLOT MAVRK_RF1
// mvrk_initialize_transceiver_radio (TRANSCEIVER_SLOT);

/* **** Initialize the Diversity Antennas **** */
/* **** */
mvrk_set_antenna_diversity (MAVRK_RF1, ANTENNA_DIVERSITY_LEFT);
mvrk_set_antenna_diversity (MAVRK_RF2, ANTENNA_DIVERSITY_RIGHT);
```

Setup-programming the uMavrk

uMavrk is attached to the
your fabricated board
(optional)

That is attached to the debug
board



Setup-programming the umavrk



Attach the debug interface to the debug board.

Build code and Load!

uMavrk Interactions with peripherals

SDA SCL



MicroController-
Master

Slave 1 - ADC

Sensor
1

Sensor
2

Slave 2 – Sensor
3

Action

I2C Process

- Master sends start bit
- Master sends 7 bit address to find slave
- Write(0) or Read(1)
- Slave responds with an active low
- Data exchange – Transmit mode or Receiver mode
- Master Sends stop bit

Questions

